A PIPE SEPARATOR FOR THE SEPARATION OF FLUIDS, PARTICULARLY OIL, GAS AND WATER

The present invention concerns a pipe separator for the separation of fluids, for example separation of oil, gas and water in connection with the extraction and production of oil and gas from formations beneath the sea bed, comprising a pipe-shaped separator body with an inlet and outlet cross-section that principally corresponds to the transport pipe to which the pipe separator is connected.
"Principally" means that the separator body may have a slightly larger diameter that is necessary to achieve stratified gas, oil and water flows in the separator.

The applicant's own Norwegian patent applications nos. 19994244, 20015048, 20016216 and 20020619 describe prior art pipe separators for the separation of oil, water and/or gas downhole, on the sea bed or at the surface. However, these solutions have the disadvantage that they cannot be cleaned internally with mechanical devices, so-called "pigs" or reamers.

The present invention represents a pipe separator solution in which it is possible to use such devices. The present invention is characterised in that a pipe bend or loop is arranged in the pipe separator or in connection with its outlet to form a downstream fluid seal in relation to the pipe separator, which is designed to maintain a fluid level in the fluid separator, but which also allows the separator and the loop to be reamed.

The dependent claims 2-4 indicate the advantageous features of the present invention.

The present invention will be described in further detail in the following by means of examples and with reference to the attached figures, where:

Fig. 1 a1), a2) show a principle drawing of a pipe separator with a fluid seal in accordance with the present invention partly seen from above a1) and from the side a2), and Fig. 1b) shows an elevation of the fluid seal itself in an enlarged scale.

Figs. 2-6 show alternative embodiments of the same pipe separator with a fluid seal.

As stated above, Fig. 1 shows a pipe separator 1 with a fluid seal 2 in accordance with the present invention. The pipe separator is connected to a well head 5 with four wells 6, shown here, via a transport pipe/supply pipe 7. Upstream of the well head 5, there is a pig magazine 8 with pigs (not shown) for pigging the downstream pipe, separator and fluid seal 7, 1, 2. The fluid seal 2 is downstream in the separator 1 and constitutes, in the example shown here and subsequent examples, an integrated part of the separator itself. The fluid seal 2 is designed as a pipe bend or loop that extends from the mainly horizontal end part 3 of the separator upwards and then downwards and across in a mainly horizontal outlet part of the separator or outlet pipe/transport pipe 4.

When designing the fluid seal 2, it is, of course, necessary to ensure that the radiuses of curvature are large enough to ensure that pigs and other relevant equipment can pass through easily.

In the above, the expression "fluid seal" is used about the invention to illustrate that the present invention can be used to separate any type of fluid consisting of two or more fluid components. However, as the example shown in the figures concerns the production of oil and gas, here it is a "water seal" for the removal of separated water from the oil flow. At the transition to the water seal 2, upstream of it, there is, therefore, a recess 9, expediently with a perforation on top of it, for draining water from the separator via a drainage pipe 10. The perforation prevents the reamer from entering the drainage opening and ensures a smooth inflow along the flow path over the recess 9. The water can be reinjected in an adjoining injection well or is transported away for treatment or storage in a tank or similar (not shown).

The method of operation of the present invention is thus that oil and water, possibly including small quantities of gas, that flow from the well head 5 are separated in the separator and the oil and the small quantity of gas present flow through the fluid seal and on to the transport pipe 4, while the separated water is drained from the separator via the pipe 10. The separator can expediently be equipped with a phase measuring

device and phase regulator to control the water level and ensure at all times that the necessary quantity of water is drained.

With the solution shown here, it is possible to ream or perform pigging of the separator and pipes connected in an easy manner.

Fig. 2 shows a solution similar to that shown in Fig. 1. Here, however, in a situation in which relatively large quantities of gas are produced (high gas/oil ratio), a cyclone is fitted in connection with the well head to separate the gas before the fluid is separated in the separator in order to avoid the formation of slugs, turbulence and the re-admixture of the fluid phase in the water seal. The gas that is separated in the cyclone can be conducted via a pipe 12 to a well nearby for reinjection or is conducted back in the transport pipe 4 downstream of the separator 1.

Fig. 3 shows an alternative solution similar to the solution shown in Fig. 2. After the well head 5, but before the separator 1, there is a slug damper 12 ahead of the inlet of the separator 1. As it will not be possible to send a pig through such a slug damper, the pig sender and pig battery 8 are arranged so that the supply pipe 13 for the pig is connected to the separator 1 downstream of the slug damper 12.

Fig. 4 shows another alternative embodiment similar to the solution shown in Fig. 1. Here, however, the gas, with a high fluid/gas ratio, is conducted in a bypass pipe 14 past the water seal. The gas pipe 14 is expediently connected to the separator upstream of the water seal 2 and is connected to the transport pipe 4 downstream of the water seal.

Yet another alternative embodiment is shown in Figs. 5 and 6. The solution is intended to be used for medium-heavy oils with dewatering of the oil phase to 0.5% water and is based on the embodiment shown in Fig. 2 in which a cyclone 11 is used to separate gas before the pipe separator 1. The oil flow from the pipe separator 1 (Fig. 5) is conducted,

after the water seal 2, to a downstream compact electrostatic coalescer 15 (Fig. 6) and subsequently to an additional oil/water separator 16 that separates any remaining water after the separation in the pipe separator 1. The gas from the cyclone 11 is conducted back to the oil flow in the transport pipe 17 after the additional oil/water separator 16.